Firmenich
芬美意

Wireless Scoring Board for Blind Panel

Xian Sun
Lin Kaixin
Qin Kaining

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1 Functionalities

The client device is easy to operate, as shown in Figure 1.1. The scores of the products to be tested need to be given using a slider. During this process, the white buttons on the left side of the scoring board can be used to calibrate the scores by speaking out the score. Finally, click the blue button to send the data to the host.

Figure 1.1 Front view of 1st generation of Scoring Board

1.1 Components of Scoring Board (Client part)

1) Signal Connector: The receiver as shown in Figure 1.2 should be directly connected to the USB port of the host computer. The goal of this is to receive data from clients.
2) Power Button: The white self-locking button in the upper right corner, as is shown in Figure 1.1

3) Displayer and Speaker Button: The white self-locking switch on the left column, as is shown in Figure 1.1. It will show scores on the screen for the manager and speak out the score for the blind employee.
4) Send button: As is shown in Figure 1.1, the blue automatic reset switch on the right column. Once it is pushed, the single score will be sent to the host computer.
5) Scoring slider: As is shown in Figure 1.1, blind employee should use this slide the sliding bar to the corresponding score position, the score range is 0.0～10.0.

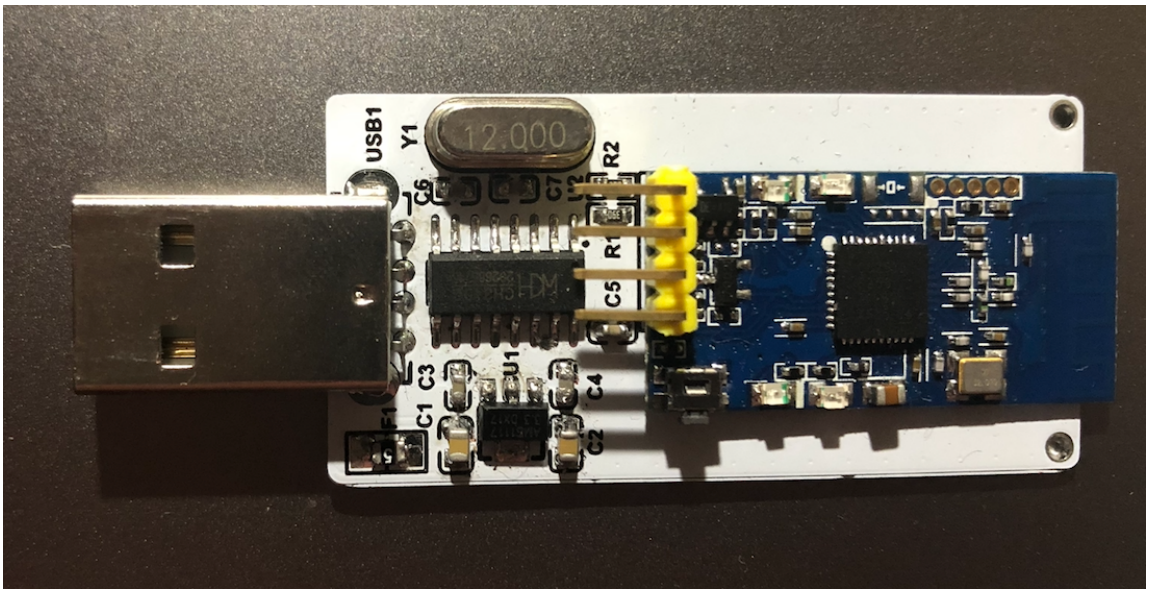


Figure 1.2 Signal Receiver USB Connector

1.2 Components of Scoring Board (Host part)

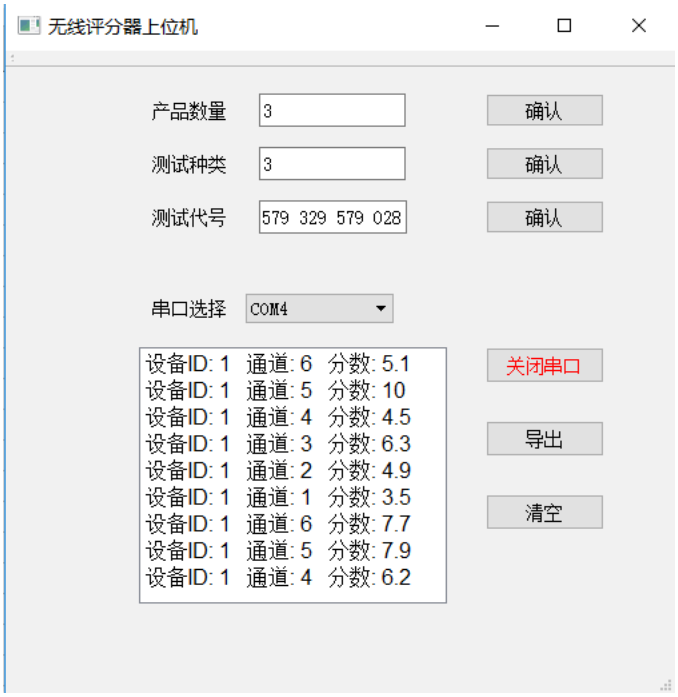


Figure 1.3 Host Application User Interface

1) Pre-value setting: input the number of test products, test feature types, test code
2) Open the serial port: select the serial port corresponding to the receiver to start the test, and the lower computer will transmit the data to the computer terminal
3) After all the data is transmitted, export the data: the data will be arranged and combined, as shown in the blue box in Figure 1.4

	A	B	C	D	E	F	G	H	I
1	序列号	导入编号	分数				特征1	特征2	特征3
2	1	329	5.1			产品329号	5.1	4.9	7.7
3	2	28	10			产品028号	10	6.3	6.2
4	3	579	4.5			产品579号	4.5	3.5	7.9
5	4	28	6.3						
6	5	329	4.9						
7	6	579	3.5						
8	7	329	7.7						
9	8	579	7.9						
10	9	28	6.2						
11									

Figure 1.4 Exported File from Host App

1.3 Power charging instructions

This product uses 5v/900ma lithium battery as power source. The charger can be used for direct charging, and the power will be cut off automatically after being fully charged. At present, the battery can supply the wireless scorer for about 8-10 hours.

2 Modules

2.1 Chip module

Using STC15 series of microchips, with ultra-high-speed dual serial ports, high-speed analog-to-digital converter, wider voltage, lower power consumption, and lower price, with higher cost performance.

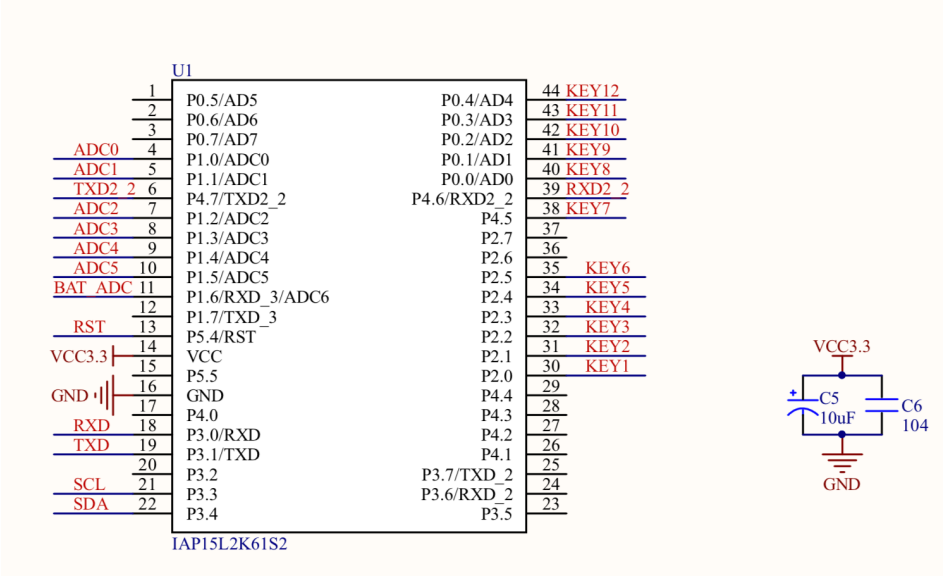


Figure 2.1 Circuit diagram of chip module

2.2 Button Modules

The key module mainly consists of six self-locking keys and six non-locking keys. The self-locking button (need to be pressed twice) is mainly used for score calibration. After the blind person hears the score corresponding to the slider, he compares it with the ideal score in his mind and makes appropriate adjustments. The unlock button is mainly used to send the calibrated score to the computer terminal.

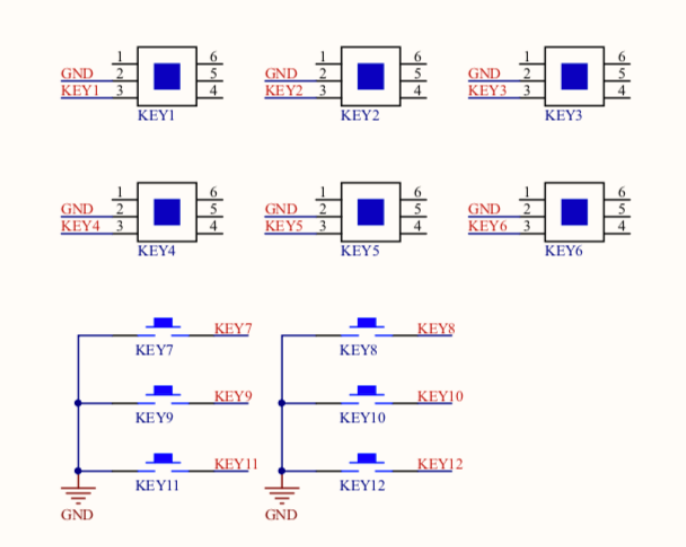


Figure 2.2 Circuit diagram of the button module

2.3 OLED Display Module

Adopting Zhongjingyuan 0.96 inch OLED display, the display area is small, it can display three color combinations of white, blue, yellow and blue, supports dual display in Chinese and English, and it is easy and reliable to write code.

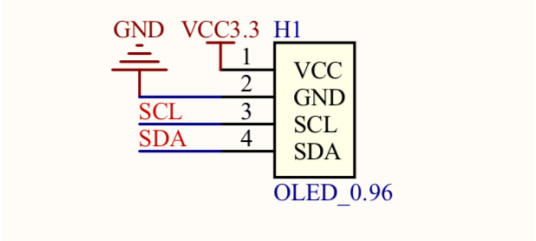


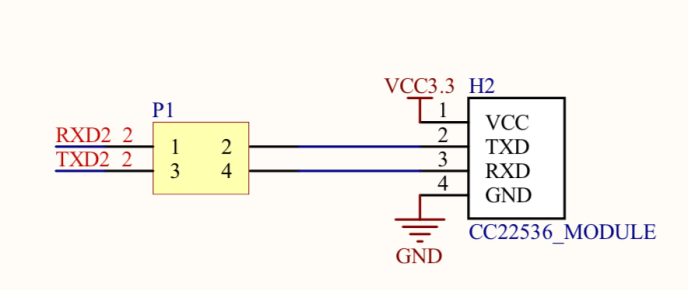
Figure 2.3 OLED display module circuit

2.4 CC2530 communication module

Using CC2530-based communication module, the frequency is in the range of 2400-2450MHz, the transmission speed is up to 3300Bps, the maximum communication distance is 250 meters, the input voltage is 3.0-5.5V, the working current is less than 30mA, and it can adapt to 2.4-GHz IEEE 802.15.4 The RF transceiver has extremely high receiving sensitivity and anti-interference performance, and the programmable output power is up to 4.5dBm.

This sample mainly uses point-to-point communication for testing, and the experimental results show that the process of sending data is stable and error-free. The module has two communication modes as follows. In the future research and development, the main development of data transmission under the broadcast mode.

1) In the point-to-point communication mode, the DL-20 wireless serial port module uses the negotiated Mac protocol, which can send and receive at high speed at the same time in both directions.
2) In the broadcast mode, the data input to a module via the serial port will be converted into wireless data and sent out by the module. All nearby nodes with the same channel will receive this data and send out their serial port.



CC2530 communication module

2.5 Slider Module

A sliding potentiometer with a length of 10cm is used as the scoring slider. The total length of the potentiometer is 12.8cm, and the resistance value within 2cm produces serious nonlinearity, and it shows slight nonlinearity at 2～5cm, and has good linearity after 5cm. The harm caused by non-linear changes makes the scores unable to match the corresponding distances, resulting in score errors. However,

the maximum error of the score generated by this scoreboard is less than 0.3, which is within the allowable range.

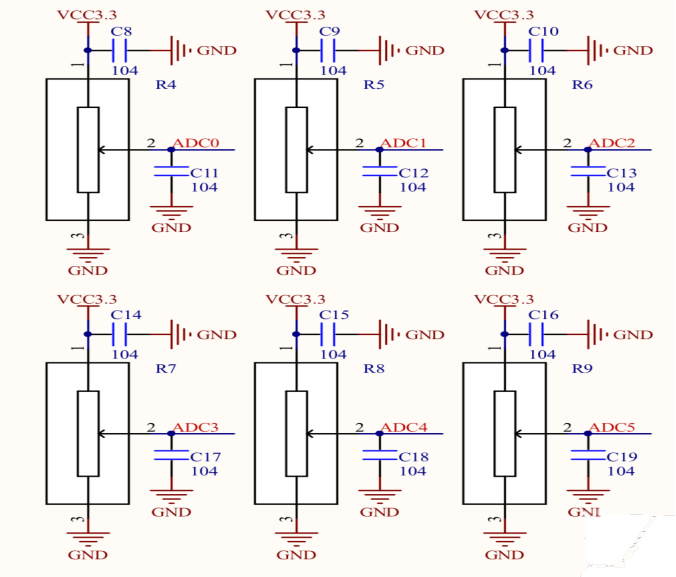


Figure 2.5 Slider module circuit diagram

2.6 Power Module

Using Zhongshun 5V polymer lithium battery 900mAh, size 6*2*1cm, maximum working current 1A, weight about 20g. The power module circuit is mainly composed of three parts:

1) Step-down circuit. The purpose of reducing the voltage from 5V to 3.3V is to keep the chip within the operating voltage range.
2) USB interface circuit. As a switching circuit connecting the battery and the chip board.
3) Working indicator circuit, as shown in Figure 2.8.

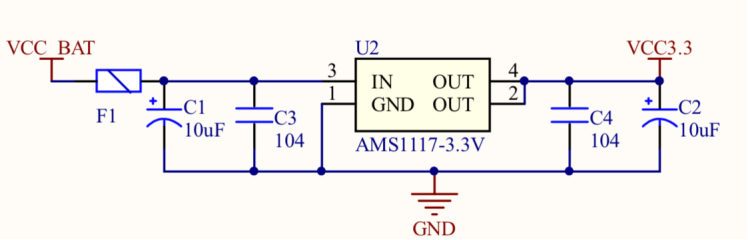


Figure 2.6 Step-down circuit of the power supply

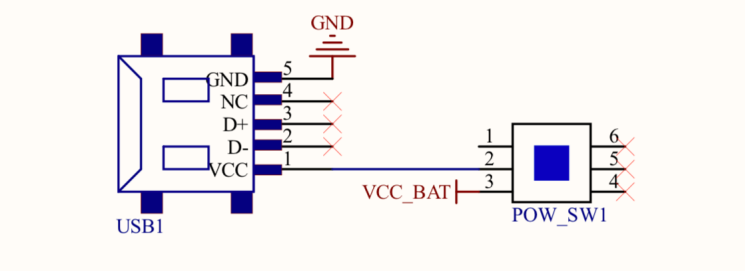


Figure 2.7 Power USB interface circuit

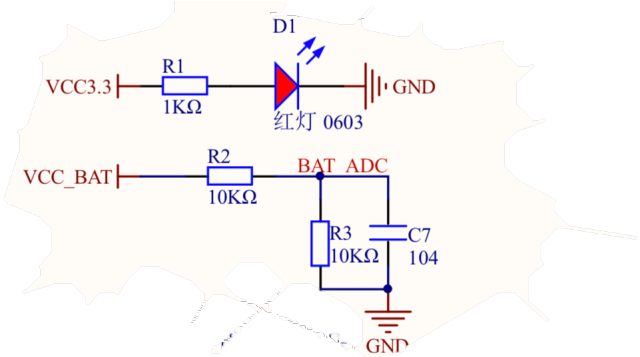


Figure 2.8 Power work indicator circuit

2.7 Voice Module

Adopt SYN6288 Chinese speech synthesis module, support GB2312, GBK, BIG5 and UNICODE internal code format text. It can synthesize arbitrary Chinese text and support the synthesis of English letters; it has intelligent text analysis and processing algorithms, which can correctly identify values, numbers, time and date and commonly used weights and measures symbols; supports 16-level volume adjustment; the foreground volume and background of the playback text The background volume of the music can be controlled separately; the speech speed can be adjusted by sending the control mark, and it supports 6-level speech speed adjustment; the final product is provided in an SSOP patch package; the volume is the smallest in the industry.

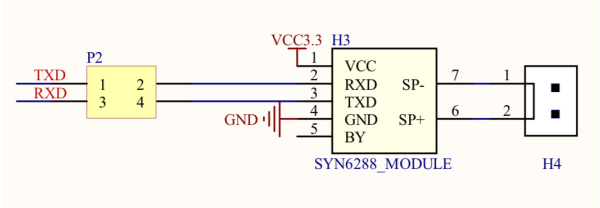


Figure 2.9 Voice module circuit

2.8 Receiver module

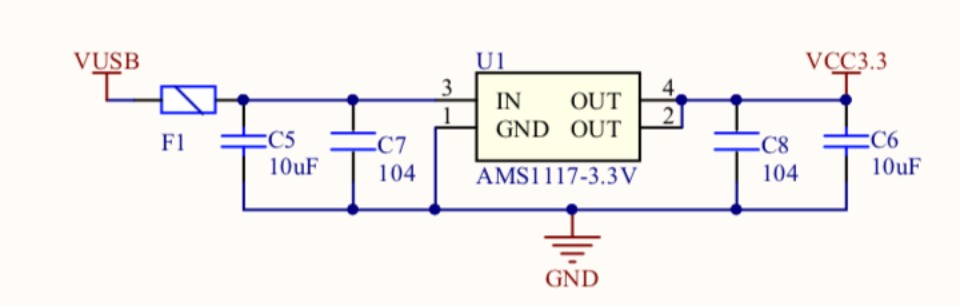


Figure 2.10 Step-down circuit at the receiving end

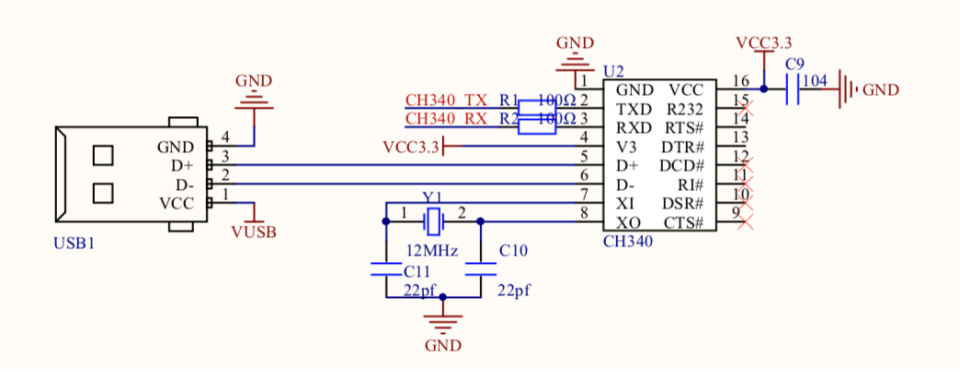


Figure 2.11 Receiver interface, crystal oscillator circuit

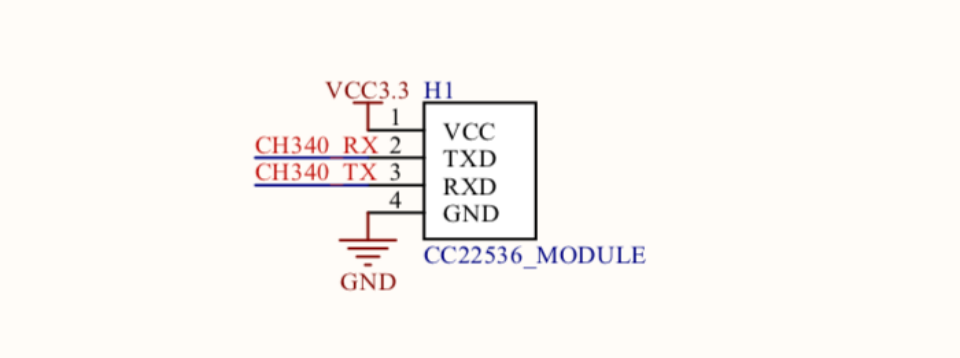


Figure 2.12 Receiver CC2530 circuit

3 Code

3.1 Client code

1) .c files

main.c：main function

delay.c：Delay function

Keypress.c：keypress related function

oled.c：oled screen control and display function

SYN6288.c：voice module

USART.c：serial communication functions, where USART1 is used for voice module and USART2 is used for communication

ADC.c: digital-to-analog conversion function

2) .h files

delay.h：Delay function header file

Keypress.h：Key press header file

oled.h：oled screen control and display function header file

oledfont.h： oled font header file

SYN6288.h：Voice module function header file

adc.h：Digital-to-analog conversion function header file

config.h：stc15 microcontroller header file

3) Communication transmission data format

Start bit: 0xfe Second bit: Length Third bit: id Fourth bit: Channel 5th bit: Data, 6th bit: End 0x80. For example, if the transmission id: 0x01 device, the data of channel 2 is 0x10, then the data format is:

0xfe 0x06 0x01 0x02 0x10 0x803.2

3.2 Host code

main.cpp：main function

QtGuiApplication1.cpp: QT interface

workthread.cpp：thread functions

WzExcel.cpp：excel: excel operation functions

WZSerialPort.cpp：serial port operation functions

SerialHelper.cpp：serial port receiving data processing

4 Hardware Components List

4.1 Scorer Components

Name	Number
SMD aluminum electrolytic capacitors	3
Chip resistor	16
Light-emitting diode	1
SMD fuse 500ma	1
0.96 inch OLED screen	1
CC2530 wireless transmission module	1
SYN6288 voice module	1
Socket 2*1 (spacing 2.54mm)	1
SWITCH_6PIN_8*8mm, self-locking switch	6
KEY_SMD_6*6*12mm, self-reset button	6
Pin header	2
Chip resistor	1
Chip resistor	2
'Slide potentiometer 128mm	6
STC15 MCU	1
LDO step-down chip	1
MICRO USB female socket MK5P	1
A56 button cap 6*6 button cap, matched with self-reset button	6
A06 round 6*7 switch button cap, matched with self-locking switch	6
Output current 500ma, self-stop when full	1
Battery 5v/900ma	1
Speaker 8 ohm 1w	1

4.2 Receiver Components

SMD capacitor C6ty	**2**
Chip capacitor 8, C	3
SMD capacitor C11	2
SMD fuse 210 500ma	1
CC2530 wireless transmission module 00ma	1
SMD resistor R2 wireless	2
LDO step-down chip-3.3	1
CH340 serial port level conversion chip 0ma	1
USB male 1AA	1
Crystal MH	1

5 Future Improvement Plan

Improvement principle: optimize hardware, reduce cost, and achieve low power consumption

5.1 Insufficiency of Client App and Improvement Plan

1) The sliding rheostat exhibits nonlinearity in the low resistance range.
   Improvement plan: Test a variety of sliding rheostats, choose a rheostat with better linearity or optimize the linear fitting of the algorithm.
2) The cost and power consumption of OLED displays are relatively high.
   Improvement plan: The use of digital tube display for digital display can reduce the cost by several tens of times and greatly reduce the power consumption.
3) The power supply voltage is constant at 5V, and an additional step-down chip circuit is required.
   Improvement scheme: Direct power supply with 3v voltage, reducing circuit complexity, improving battery efficiency, thereby reducing power consumption and cost.
4) The CC2530 wireless transmission module currently uses one-to-one point-to-point communication, which can only realize single-machine data transmission.
   Improvement plan: Set the module to one-to-many communication mode and conduct multiple scoreboard tests to prevent data leakage and failure to send at the same time.
5) There is no power display.
   Improvement plan: You can add a low-battery alarm module for the power supply. Automatic low-battery alarm will be issued when the power is lower than 20%.
6) The charging interface plug is not fixed.
   Two protruding cylinders are designed on the shell plate to fix the charging port and prevent sliding.

5.2 Lack of Host App and Improvement Plan

At present, only the data transmitted by one scoreboard is processed. If the data uploaded by multiple scoreboards are processed, the following aspects need to be improved:

1) The number of scorers needs to be increased during the pre-value setting stage.
2) Add multi-channel test code input (or read excel directly). Because different scorers assign different test codes, it is necessary to match and input each set of specific test codes.
3) Output the final data in Excel form, as is shown in Figure 5.1.

	A	B	C	D
1		测评员编号	奶味（特征1）	咖啡味（特征2）
2		1		
3		2		
4		3		
5	产品编号1	4		
6		5		
7		6		
8		7		
9		8		
10		9		
11				
12		测评员编号	奶味（特征1）	咖啡味（特征2）
13		1		
14		2		
15		3		
16	产品编号2	4		
17		5		
18		6		
19		7		
20		8		
21		9		

Figure 5.1 The improved output EXCEL table format